3. Height adjustment

2. Power on

6. Keystone

5. Zooming

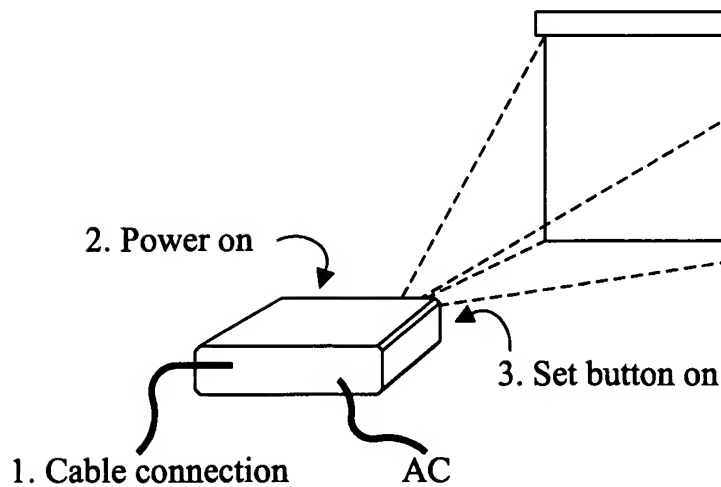4. Focus

1. Cable connection   AC

6-step procedure is required to project
an image in the right way.
(Steps 3-6 are repeated to make right
adjustment by confirming the results
of adjustment each time)

FIG. 1 (PRIOR ART)

2. Power on

3. Set button on

1. Cable connection   AC

Setting free model enables
right image projection by
just pressing the power
switch and set button.

FIG. 2

FIG. 3

```
            │
            ▼
┌───────────────────────┐
│   Initiate Keystoning  │
└───────────────────────┘
            │
            ▼
┌───────────────────────┐
│      Auto Focus        │
└───────────────────────┘
            │
            ▼
┌───────────────────────┐
│  Keystone Calibration  │
└───────────────────────┘
            │
            ▼
```
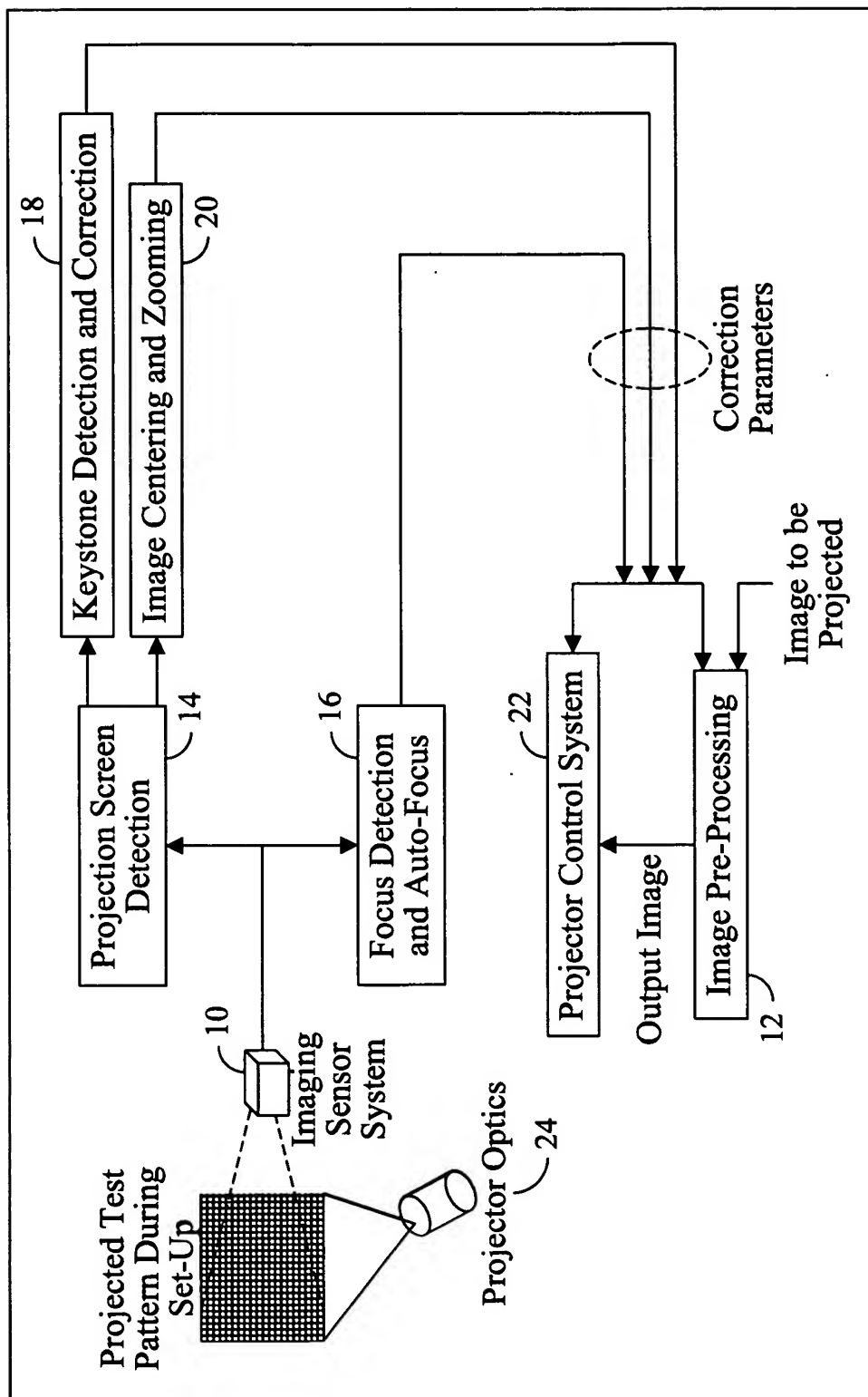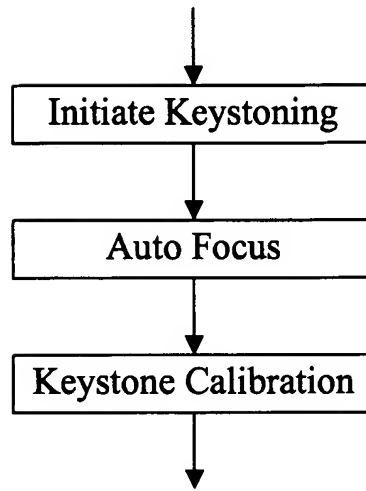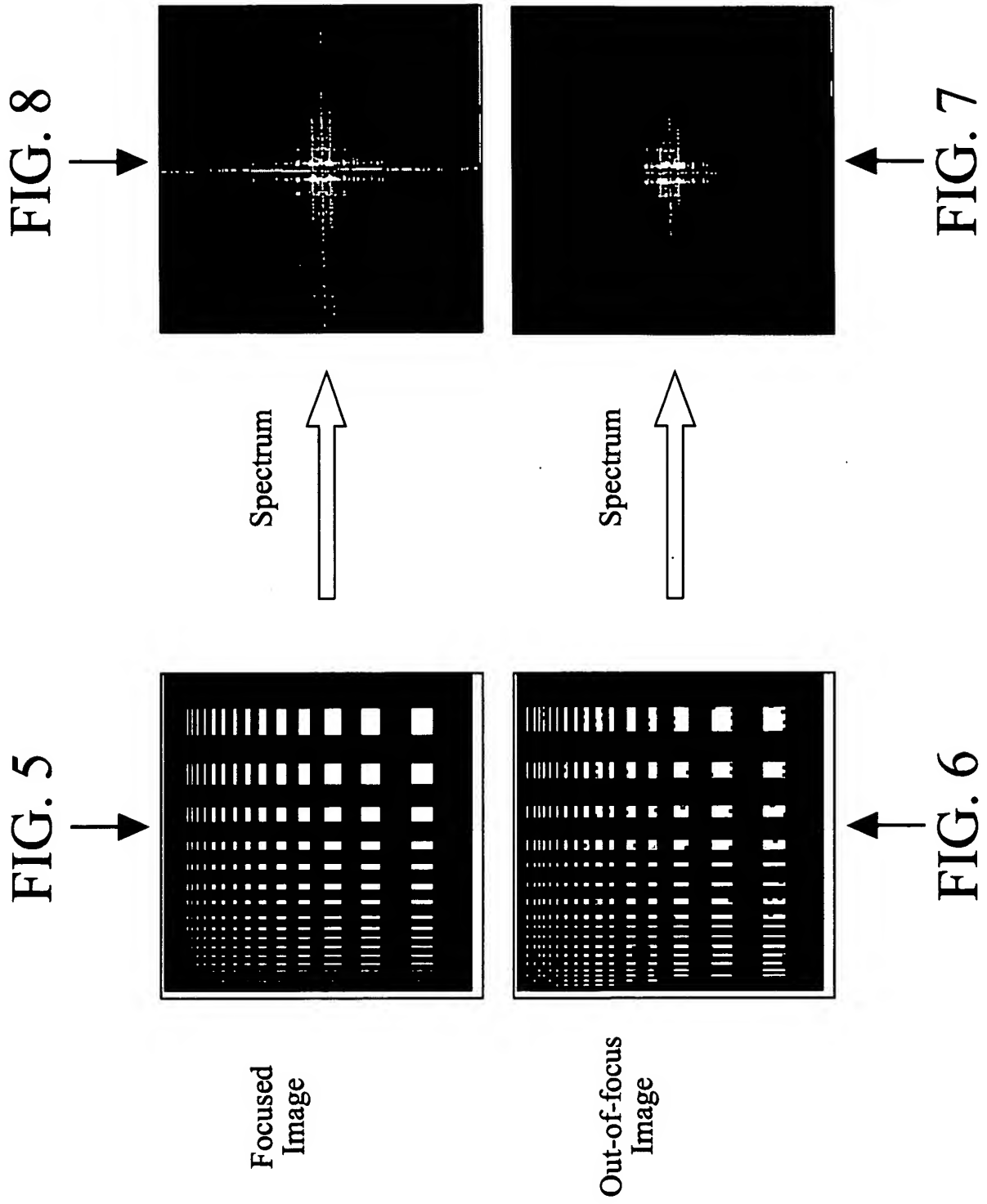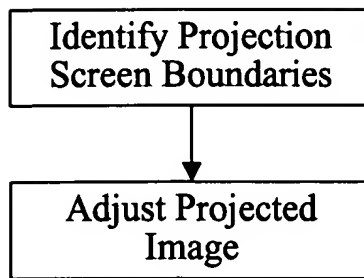
FIG. 4

FIG. 8

FIG. 7

Spectrum

Spectrum

FIG. 5

FIG. 6

Focused
Image

Out-of-focus
Image

Identify Projection
Screen Boundaries

↓

Adjust Projected
Image

FIG. 9

An input line

↓

| Median Filter | ⌐∼ 80

↓

| Gradient Computation | ⌐∼ 82

↓

| Zero-crossing/Peak Locator | ⌐∼ 84

↓

| Candidate Pair Matcher | ⌐∼ 86

↓

| Statistical Inference
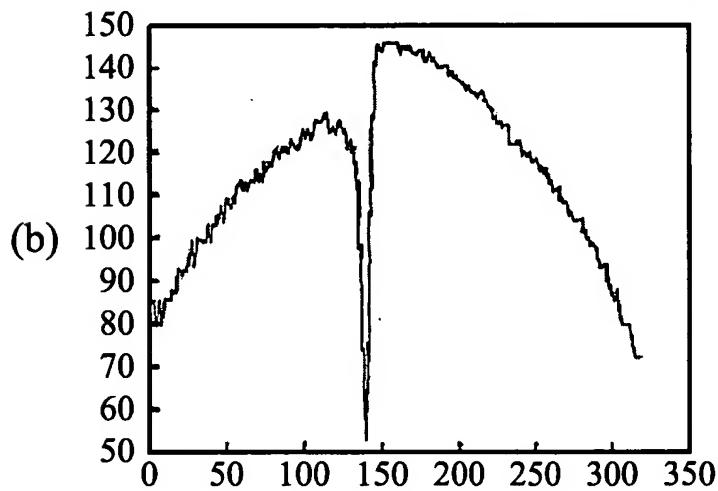(Choosing the Final Pair) | ⌐∼ 88

↓

Screen location

FIG. 10

(b)
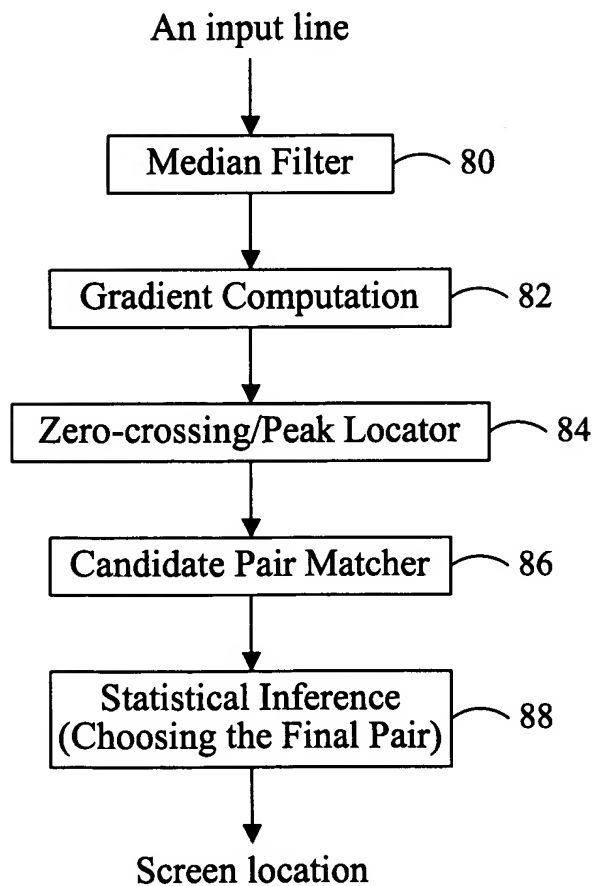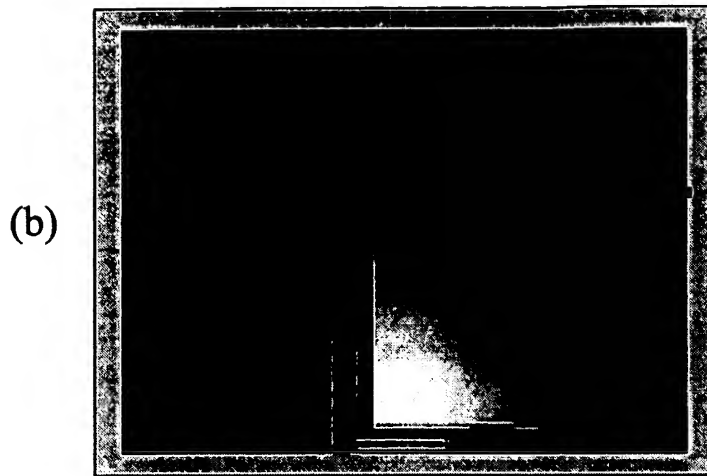
An image of the screen from the projector's perspective. The line is assumed to be the one row that the 1-D sensor can sense.

(b)

The luminance values of the row in (a), illustrating that working in the luminance domain there may be no region that is uniform (and thus is potential screen area).
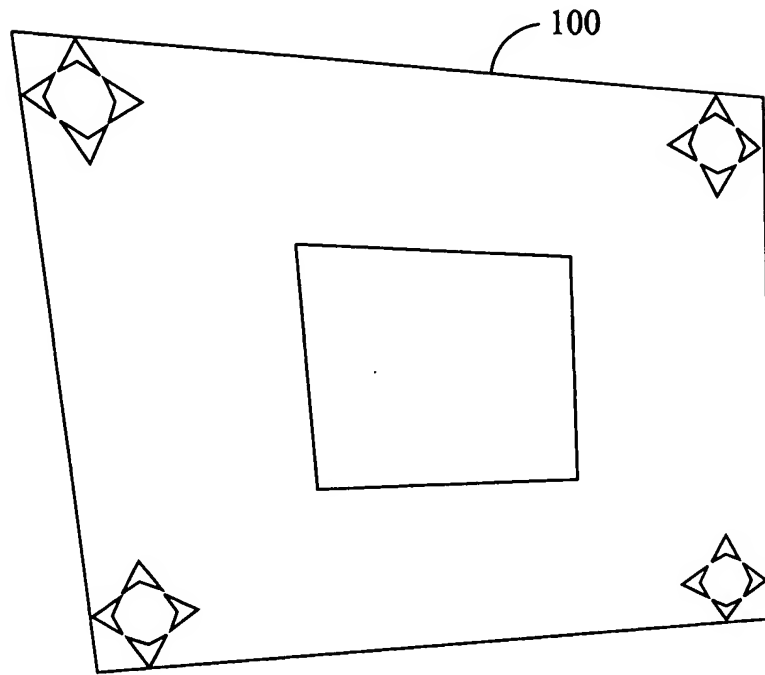
(c)

The gradient of (b).

FIG. 11

100

FIG. 12
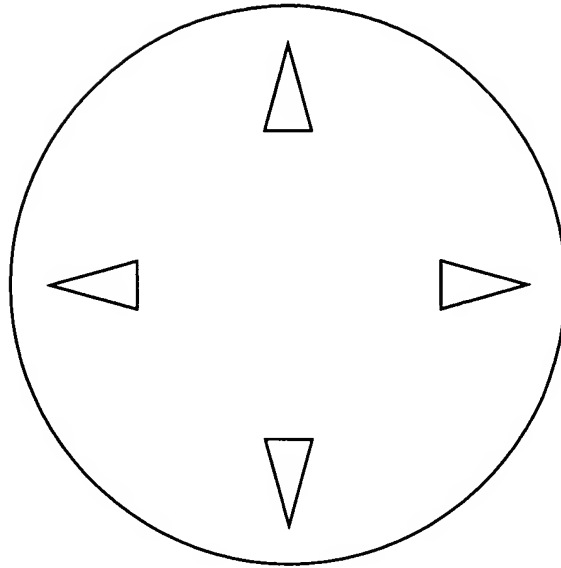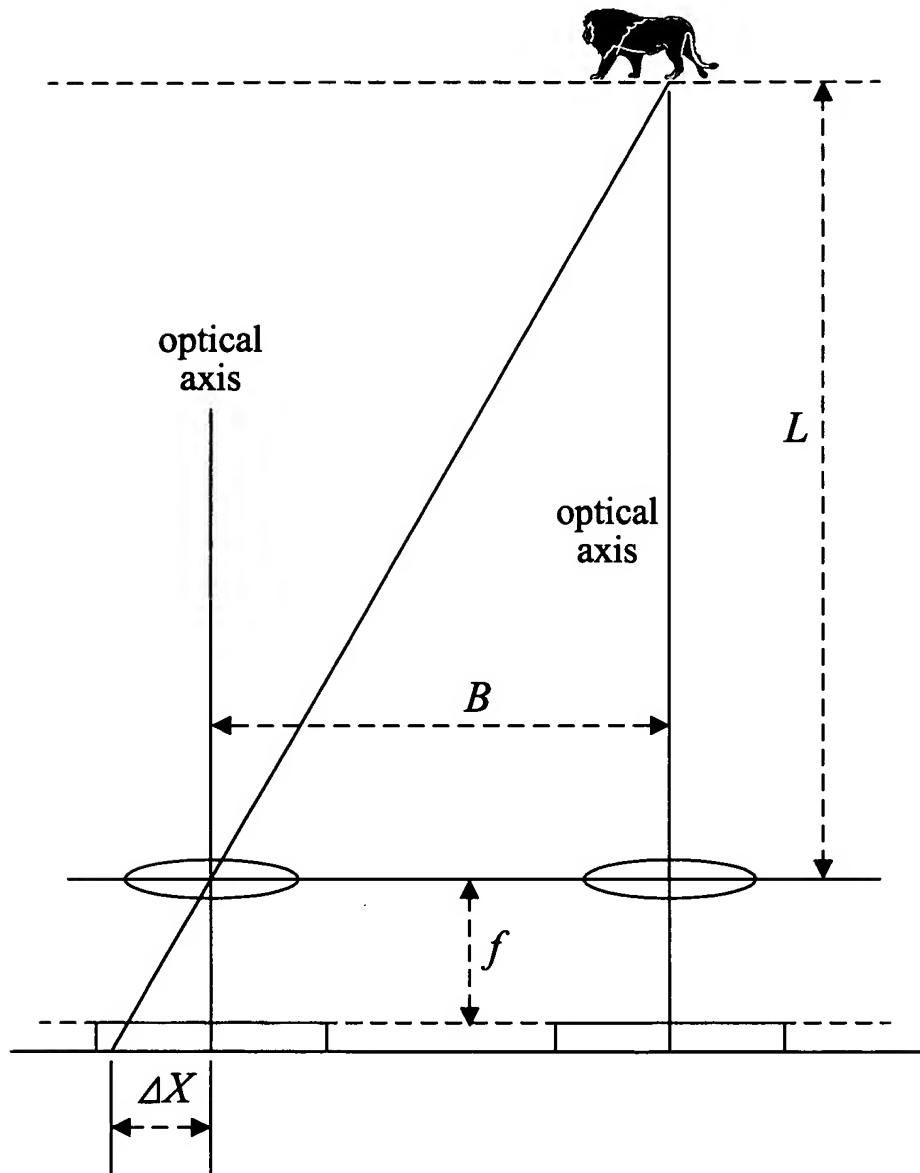
FIG. 13

optical
axis

optical
axis

L

B

f

$\varDelta X$
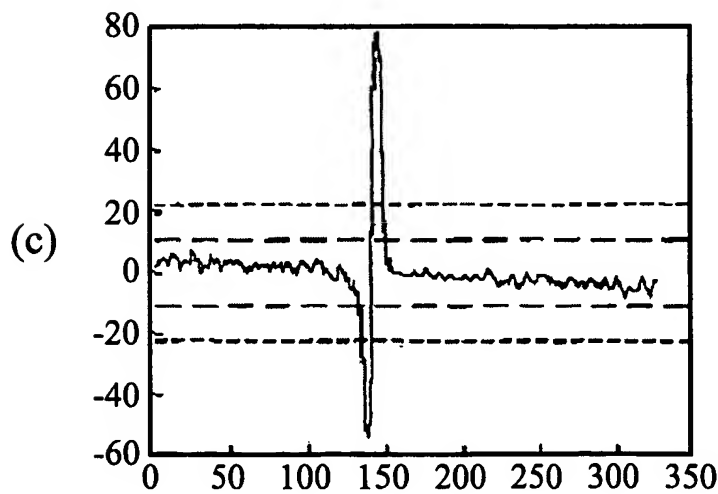
Based on the similarity of the triangles, the distance L is computed as a function of the sensor parameters (B and f) and the disparity $\varDelta X$ (difference between the two images of the same physical point):
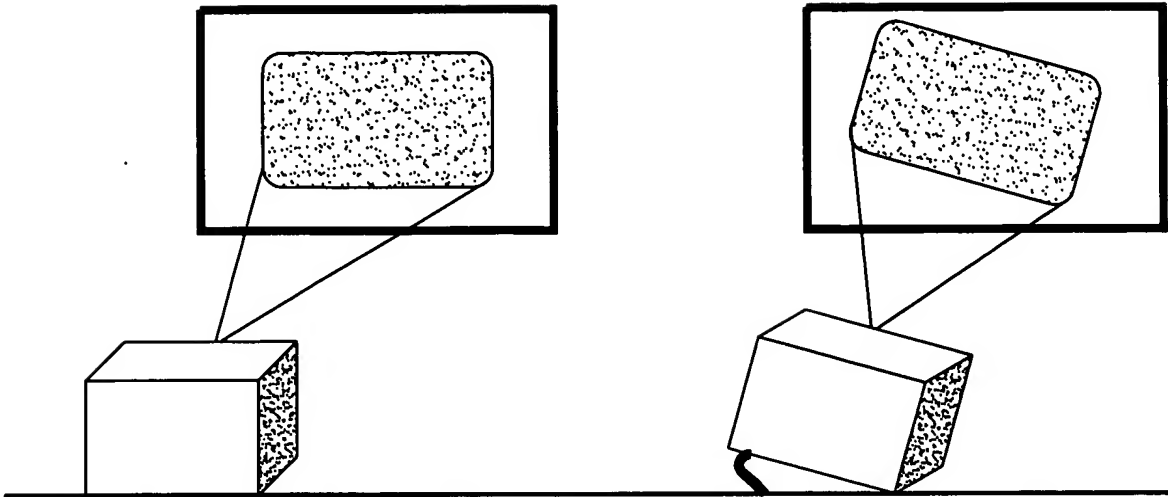
$$L = \frac{Bf}{\varDelta X}$$

FIG. 14

FIG. 16

FIG. 15